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RESEARCH PROGRAMS CONDUCTED BY THE NUCLEAR REGULATORY COMMISSION

OVERSIGHT REPORT

BY THE

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
NINETY-SEVENTH CONGRESS

SECOND SESSION

SEPTEMBER 1982

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LETTER OF SUBMITTAL

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C., September 8, 1982.

Hon. THOMAS P. O'NEILL, JR.,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Technology, I submit herewith the Committee's report to the 97th Congress. The Committee's report is based on an oversight study made by its Energy Research and Production Subcommittee.

Sincerely,

DON FUQUA,
Chairman, Committee on Science and Technology.

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LETTER OF TRANSMITTAL

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C., September 8, 1982.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology,
U.S. House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: The Subcommittee on Energy Research and Production held oversight hearings May 18 and 19, and June 15 on research conducted by the Nuclear Regulatory Commission. Although this is the first time that the Subcommittee has held hearings on NRC's entire research program, we have followed with interest its growth and evolution for many years.

The $220 million that NRC spends on research represents approximately half the total NRC budget. In the current economic climate, we felt it essential that the program be subjected to critical technical review. The enclosed report describes our oversight findings and recommendations. It should be noted that the NRC Commissioners testifying on June 15 expressed agreement with many of the Subcommittee's findings.

We intend to track NRC's response to our recommendations, as well as to follow up this general oversight with periodic reviews of specific program areas.

Sincerely,

MARILYN L. BOUQUARD,
Chairman, Subcommittee on Energy Research and Production.

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OVERSIGHT FINDINGS AND RECOMMENDATIONS ON RESEARCH PROGRAMS CONDUCTED BY THE NUCLEAR REGULATORY COMMISSION

Introduction

The Subcommittee on Energy Research and Production held hearings on May 18 and 19 and June 15 on the research program conducted by the Nuclear Regulatory Commission (NRC).

Witnesses on May 18 and 19 included the director of the NRC Office of Nuclear Regulatory Research, representatives of the Advisory Committee on Reactor Safeguards (ACRS), the Electric Power Research Institute (EPRI), the Institute of Nuclear Power Operations (INPO), the Nuclear Safety Oversight Committee (NSOC), and the U.S. Department of Energy (DOE). A complete list of witnesses is provided in Appendix A. (See p. 15.)

On June 15, the Commissioners of the NRC were invited to respond to preliminary findings and recommendations resulting from an analysis of both testimony from the May hearings and responses to a confidential survey of nuclear industry representatives, which was conducted in conjunction with the hearings. A summary of survey responses is attaached to this report as Appendix B. (See p. 17.)

The major findings and recommendations from this oversight activity are described below.

General

Testimony presented before the Subcommittee supports the continuing need for a strong research program at the NRC. Dr. Kouts cites two reasons for continued research on nuclear safety. The first is the fundamental nature of the NRC's mission to assure the public health and safety as nuclear power becomes increasingly important to the nation's energy supply. The second is that "* * * the safety requirements for reactors include very substantial conservatisms to account for the lack of precision in our knowledge of certain parts of the safety analysis. The only basis on which to reduce these conservatisms is development of more precise knowledge through research and experience." In support of the latter motive he states that "it is important that regulatory bodies not penalize society any more than is called for by prudent regard for safety."

Those NRC research programs examined by the Subcommittee staff were found to be generally of a high technical caliber. This conclusion was supported by the testimony presented before the Subcommittee, and the survey responses from industry representatives. Both the hearings and survey responses, however, exhibited serious concern about the management of NRC research, particularly in regard to the establishment of research priorities and the definition of technical objectives. As described in the findings below, major problems are rooted in the organizational structure of the Commission, which doesn't clear-

ly assign responsibility for defining programs and allocating research resources to those people who have the information and expertise to assess the costs and potential benefits of research projects. In a number of the findings, such as those regarding the relationship of the Office of Nuclear Regulatory Research to industry, the Commission is viewed as aware of the problems and moving in the right direction but requiring substantial additional improvement.

Findings and Recommendations—Summary

FINDINGS	RECOMMENDATION
1. Results of research directed by the Office of Nuclear Regulatory Research are not adequately reflected in the rules and regulations of the NRC.	1a. Expedite review of 10 CFR 50, Appendix K. 1b. Review research programs and list major regulatory impacts.
2. The distinction historically drawn between "confirmatory" and "safety" research at NRC is artificial and counter-productive.	2a. Reword the charter of the Office of Nuclear Regulatory Research to support more broadly the overall mission of NRC. 2b. Expand research on the impact of regulatory formats and processes on assured and improved safety.
3. The setting of research priorities at the NRC is an ad-hoc process with no overall framework or systems overview and very little delineation of potential costs and benefits for individual programs.	3a. Restructure the long range research plan to: —include introductory material describing a logical framework relating research projects to unresolved safety issues; —reorganize program-specific detail to fit this framework; —clearly delineate areas where future research is needed, even if current budget limitations preclude initiating projects in the upcoming fiscal year; —explicitly define deliverables to be provided to user offices; —include in the plan estimates of necessary resources and recommended schedules, even if these have to be heavily qualified (no penalties should be applied for modifying these schedules and resource estimates as programs become better understood). 3b. Submit to Congress with the budget request for each fiscal year a description of deliverables, major intermediate milestones, total estimated resource requirements and potential impact on safety for each program. 3c. Develop a systems engineering organization to formulate an overview of factors affecting plant safety and to set research priorities and objectives accordingly.
4. NRC's dominant role in U.S. safety research, combined with its detailed regulatory policy, contribute to an atmosphere in which licensee research rescources tend to be focused on assuring compliancce rather than on the development of long-term plant-safety improvements.	4a. Place increased emphasis on the licensee's safety responsibility by requiring more safety research of the industrial community.

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5. Despite a strong recent trend toward increasing cooperation between the Office of Nuclear Regulatory Research and the industrial community, the current interface is not adequate for NRC researchers to incorporate maintenance and operations considerations into their safety research.	5a. Continue to increase substantive cooperative programs with EPRI and INPO involvement. 5b. Request EPRI or INPO review at the initiation or completion of any NRC research program involving operational procedures or reactions either as an input or as a deliverable product. 5c. Formally invite EPRI comments on the NRC research budget and on the Long Range Research Plan when these documents are reviewed by the Advisory Committee on Reactor Safeguards (ACRS).
6. The interface between the Office of Nuclear Regulatory Research and the Department of Energy is neither clearly defined nor well understood.	6a. Establish with DOE a cooperative review committee to coordinate research of mutual interest and to recommend regulatory changes to reflect research results. 6b. Negotiate specific memoranda of understanding with the Department of Energy to cover LWR safety research, advanced reactor safety research, and research on safe management of nuclear waste. 6c. Review all current research at NRC and DOE on advanced reactors and waste management. Coordinate the respective programs of the two organizations to eliminate any unnecessary duplication of effort. 6d. Continue cooperating with the Department of Energy as they define a comprehensive reactor safety research program pursuant to Public Law 96-567.
7. Research activities at NRC not directed by the Office of Nuclear Regulatory Research are not adequately integrated with the overall research program.	7a. Coordinate all technical assistance programs through the Office of Nuclear Regulatory Research.

FINDINGS AND RECOMMENDATIONS—EXPLANATION

1. *Finding:* Results of research directed by the Office of Nuclear Regulatory Research are not adequately reflected in the rules and regulations of the NRC.

This finding was strongly supported both in testimony offered before the Subcommittee and in responses to the industry survey conducted by the Subcommittee staff. The Reactor Safety Research Review Group of the Nuclear Safety Oversight Committee (NSOC) "found a widely held perception among reactor safety researchers that the results of research do not lead to corresponding changes in regulations, particularly in those cases in which the results show the

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regulations to be based on conservative assumptions." In testimony before the Subcommittee, Dr. Herbert Kouts, representing this group recommended that "the Commission encourage visible integration of the results of research into the regulatory process."

Industry comments evidenced a widespread concern that the NRC has no incentive to relax conservative regulations. While a number of examples were cited to support this contention, by far the most frequently mentioned was the neglect of the NRC to revise 10 CFR 50, Appendix K in response to results of tests on Emergency Core Cooling Systems conducted at the LOFT facility in Idaho. Mr. Minogue, in oral testimony, referred to a reluctance on the part of industry to support a broad and sweeping review of Appendix K until more data are available. The Subcommittee staff, however, found total agreement among industry representatives that research data in hand today would adequately support a long-overdue revision.

A possible explanation for this discrepeancy between industry's view and NRC's perception of it is contained in a personal follow-up letter from Dr. Kouts, who was the first director of the NRC research program. Dr. Kouts is currently Chairman of the Department of Nuclear Energy at Brookhaven National Laboratory Associated Universities. He writes, "the industry has learned to live with the excessive conservatisms required by NRC, and would prefer not to start down any new paths that have unforeseeable consequences. Furthermore, plant designs are quite rigid, and it is difficult to see how economic benefit could be gained from relaxation of the conservatisms." He goes on, "I . . . believe that the industrial views I have outlined are too cautious. The ability now possible to alter practices in ways that would benefit the ratepayer should be explored seriously . . ." The "unforeseeable consequences" feared by industry include the possibility that a new rule may stimulate design or operational changes while ultimately being no more representative of established research conclusions than existing regulations currently being met.

Recommendations:

1a. Expedite review of 10 CFR 50 Appendix K.

The NRC could significantly improve its credibility in industry for applying research results simply by conducting a rational review and revision of Appendix K of 10 CFR 50. The Commission should develop an accelerated schedule for completing any additional research required, and reviewing and revising Appendix K.

1b. Review research programs and list major regulatory impacts.

The Office of Nuclear Regulatory Research should list regulations likely to be substantively impacted (or confirmed) by current and planned research programs between fiscal year 1984 and fiscal year 1988 (the years covered by the Long Range Research Plan). Target dates for review of these regulations should be specified. The Commission should be directed to review this list at least annually to assess progress in applying research results to regulations. Special attention should be focused on NRC requirements identified by the nuclear safety

research community outside NRC as unduly conservative or narrow, such as those impacted by fission product release and transport and those relating to seismic design of piping.

From the industry's point of view, increased understanding of fission product release and transport in a severe accident is a top priority because of its impact on reactor siting and emergency procedures and its potential effect on public perception of nuclear power. Mr. Taylor, in his response to follow-up questions from the Subcommittee hearings states that:

> Initial evidence indicates that the above research [on potential radionuclide releases] will yield the following results:
>
> 1. Fractions of radioiodine and radioactive particulates released to the environment are substantially reduced, perhaps by a factor of 10 to 100.
>
> 2. The time before release of noble gases and reduced fractions of volatiles is extended from minutes to hours or even days.
>
> The combination of these resu ts would substantially alter the technical basis from which present evacuation and warning requirements were derived and should therefore lead to reduced requirements for warning systems, a small emergency planning zone, and less emphasis on evacuation. The need for predistribution of potassium iodide tablets to the public, which is questionable even under the present basis would disappear. These changes, if proven, should not be set aside in favor of maintaining the levels of emergency preparedness now stipulated in NRC requirements. The cost in terms of public apprehension and misunderstanding, as well as the personnel and equipment cost to the industry for unneeded capability, are too great. Hopeful'y, this research will be completed on a sufficiently urgent schedule to effect realistic emergency plans promptly.

Dr. Kouts testified along the same lines that "* * * there is now widespread belief that this [radioactive] source term may have been greatly overestimated in the past."

2. *Finding:* The distinction historically drawn between "confirmatory" and "safety" research at NRC is artificial and counterproductive.

There seems to be general agreement that the Office of Nuclear Regulatory Research ought to conduct whatever research is necessary to support the NRC mission of assuring public health and safety within the bounds of its jurisdiction. Although the restriction of the NRC from developmental work in support of the nuclear industry is essential, the Office of Nuclear Regulatory Research ought to be free to view safety research in the broadest possible context.

In testimony before the Subcommittee, Dr. Kouts expressed opposition "to NRC policies that tied the research programs to confirmatory objectives," and suggested that "research should be allowed to point the way to improved safety when this seem[s] appropriate."

Dr. Siess, representing the Advisory Committee on Reactor Safeguards (ACRS) testified that "NRC's Office of Nuclear Regulatory Research is still constrained to emphasize confirmatory research" and said that ACRS has "had a long interest in research to improve safety." He worried that "there are such programs * * * but they still represent a small part of the NRC's research program."

Chairman Palladino of the NRC stated that "While in the past confirmatory research may have been overly emphasized, * * * some confirmatory research is still necessary," but he went on to assure the Subcommittee that "the Office of Nuclear Regulatory Research conducts whatever research is necessary to support the NRC mission."

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In summary, the Subcommittee finds that available funds should be allocated to those projects judged most useful in an overall safety context. The Commission has moved steadily in this direction since the TMI–2 accident; they should accelerate this trend.

Recommendations:

2a. Reword the charter of the Office of Nuclear Regulatory Research to support more broadly the overall mission of the NRC.

Despite assurances by the Commission that the NRC conducts any research consistent with its mission, the restriction to confirmatory research is firmly embedded in the Commission's history.

In response to questions submitted for the record of the hearings, the ACRS stated that:

> * * * the distinction between "confirmatory research" and "research to improve reactor safety" is neither very clear not useful, if indeed there ever was a legitimate distinction * * * The ACRS suggests that the Congress review the legislative charter of the NRC research program and eliminate this distinction. Inasmuch as the purpose of the NRC is to ensure safe design, construction, and operation of nuclear powerplants, it should follow that any research is legitimate that contributes to that purpose without compromising the credibility or independence of the NRC.

The Subcommittee agrees. A clear statement that outlines the objectives of the Office of Nuclear Regulatory Research in terms of enhanced or ensured safety without explicitly distinguishing between "confirmatory" and "improved safety" research would go a long way towards overcoming historical biases.

2b. Expand research on the impact of regulatory formats and processes on assured and improved safety.

Since the objective of regulations is to promote safety in operating nuclear reactors, the structure of regulations and the process of applying them ought to be subjects for research in their own right. The small amount of research currently supported in these areas should be nurtured and slowly expanded to assure that the regulatory process is as effective as possible. One of the respondants to the industry survey represented this position in noting that the current regulations by their very nature fragment the plant into subsystems. Research programs, on the other hand, attempt to deal with complex interactions among subsystems having an integrated effect on the entire plant. To address this fundamental problem, the Office of Nuclear Regulatory Research should continue to study regulatory formats which would better account for overall plant safety.

3. Finding: The setting of research priorities at the NRC is an ad-hoc process with no overall framework or systems overview and very little delineation of potential costs and benefits for individual programs.

The responsibility for setting research priorities at the NRC is fragmented between the user offices and the Office of Nuclear Regulatory Research (RES). No NRC office or organization can be currently held accountable for making the trade-offs necessary to allocate resources across the many research projects funded by the NRC.

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The research organization views its role as responsive to the needs of its users. The user officies, however, lack the technical overview necessary to assess the relative utility of diverse research projects. RES tries to ameliorate this shortcoming by developing annually a five-year Long Range Research Plan and a budget proposal for the upcoming fiscal year and circulating both for comment by user offices. Unfortunately, neither of these documents adequately describes program deliverables [1] and schedules in a form useable for making decisions on research priorities. Furthermore, even with the accompanying resource estimates, the Long Range Research Plan does not associate costs with specific deliverables in a way which supports decision-making.

Mr. John Taylor of EPRI supported the aforementioned conclusion in testifying before the Subcommittee that "NRC's program needs to be prioritized and then formulated around specific deliverables related to resolution of safety issues or confirmation of safety."

As Mr. Minogue assured the Subcommittee in his testimony, the final version of the Long Range Research Plan covering fiscal years 1984–1988 is an improvement over earlier drafts in providing a framework for the voluminous descriptive material on "decision elements;" and the entire document is an improvement over last year's version in providing "cross-cuts" between "decision elements." Nevertheless, the Plan is still fundamentally inadequate as a planning tool for managing the considerable resources devoted to NRC research. None of the documents supplied by RES to its user offices provides any explanation justifying the particular programs supported as those most worthy of continued support. The ACRS recently stated that "the Plan is not a true long range plan but only a projection of current programs and programs planned to answer current questions." Commissioners Ahearne and Asselstine agreed that although the document is improving each year, it is not yet an adequate tool for evaluating priorities. In the words of Mr. Ahearne, "At the present time * * * it is much more an attempt to pull together work that is there, as opposed to trying to put a framework down of priorities and then [identify] what pieces fit into those priorities."

In its report to the President last fall the Reactor Safety Research Review Group of the Nuclear Safety Oversight Committee suggested a restructuring of the plan. Dr. Kouts described the intent of this recommendation to the Subcommittee: "* * * instead of having it divided by the decision units which it now takes on, that it be structured according to * * * the problems which NRC wishes to solve."

The lack of emphasis on deliverables has two additional detrimental consequences. First, research conducted to reduce uncertainty in a particular area is completely unbounded until specific objectives are defined in a form which invites comparison of current understanding with the degree of understanding appropriate to the objective. This was a major conclusion supported by the industry survey which indicated that NRC often pursues research well past the point of diminishing returns. Second, the absence of defined and scheduled deliverables understood by the user offices decreases the chances that research results will be incorporated into revised regulations.

[1] The term "deliverables" is used here to represent products that the Office of Nuclear Regulatory Research supplies to user offices. A computer code can be a deliverable if the capabilities and limitations of the code are fully specified. A specific recommendation for revising a particular area of the regulations is another example of a deliverable. Increased understanding of a technical phenomenon is not a deliverable.

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Recommendations:

3a. Restructure the long range research plan to:

—Include introductory material describing a logical framework relating research projects to unresolved safety issues; [2]

—reorganize program-specific detail to fit this framework;

—clearly delineate areas where future research is needed, even if current budget limitations preclude initiating projects in the upcoming fiscal year;

—explicitly define deliverables to be provided to user offices;

—include in the plan estimates of necessary resources and recommended schedules, even if these have to be heavily qualified (no penalties should be applied for modifying these schedules and resource estimates as programs become better understood)

The Long Range Research Plan should continue to evolve into an effective planning tool which describes current and projected safety issues in an overall framework and relates individual programs to these issues. The document should explicitly address factors such as risk significance, regulatory significance, and cost effectiveness which bear on the prioritization of programs even though these factors are not always quantifiable. The considerable effort that is expended in such a restructuring will pay continuing dividends by improving program focus and enhancing the impact of research on the regulatory process.

3b. Submit to Congress with the budget request for each fiscal year a description of deliverables, major intermediate milestones, total estimated resource requirements and potential impact on safety for each program.

Assessments of potential impact on risk to the public should be included where applicable. Other factors bearing on the establishment of program priorities should be stated explicitly for each program element. Deliverables should be specific, especially when they could potentially impact regulations.

3c. Develop a systems engineering organization to formulate an overview of factors affecting plant safety and to set research priorities and objectives accordingly.

This group could logically grow out of the organization currently addressing systems and reliability analysis. However, more emphasis must be placed on application of relevant methodologies, in addition to that directed toward development and standarization of new methodologies. To be effective, the group would have to be given responsibility for setting research objectives and directing research resources, rather than merely providing studies and analyses that may or may not be used.

The NRC should continue to develop Probabilistic Risk Assessment (PRA) techniques which can help them to investigate the relative importance of various threats to reactor safety. On the other hand, this methodology should not be viewed as the sole analytical approach for establishing the safety significance of research projects. The fact that

[2] An example of a logical framework is that used by the NSOC Reactor Safety Research Review Group to comment on the fiscal year 1982 research program.

PRA is not sufficiently well developed to answer all priority questions should not be used as a justification for neglecting to employ a systematic structure for setting priorities. Even qualitative comparisons used to allocate resources should be explicitly stated so that the rationale for program funding is evident. The research organization should develop and apply systems engineering expertise, rather than trying to formulate merchanistic, quantitative techniques for setting priorities automatically. This systems engineering organization would be the appropriate group to provide the introductory framework recommended for the Long Range Research Plan and cost/benefit analyses for new and existing research programs.

4. *Finding:* NRC's dominant role in U.S. safety research combined with its detailed regulatory policy, contribute to an atmosphere in which licensee research resources tend to be focused on assuring compliance rather than on the development of long-term plant-safety improvements.

The ultimate responsibility for operating safe plants can only be assumed by the licensee. The size of the NRC research budget relative to industrial safety research resources and the NRC's regulatory approach of specifying detailed safety "fixes" combine to produce the impression that the NRC is primarily responsible for safety and that compliance with NRC regulations relieves the licensee of his responsibility. This situation cannot be rectified solely through changes in NRC's approach to research. However, a regulatory policy which emphasizes overall safety objectives and encourages industry to conduct research on specific systems to meet these goals, could serve to underscore the licensee's primary safety responsibility.

The recent approach of the NRC to safety research for the Clinch River Breeder Reactor provides a model of a relationship where the licensee is held responsible for assessing and assuring the safety of his plant with NRC research devoted to understanding and validating the licensee's analysis with as little duplication of effort as is possible. In testimony on this project, Mr. Minogue referred to ". . . a feeling on [NRC's] part that in the regulatory process [NRC] should give more attention to what an applicant should do to support his own application." The Subcommittee endorses this view.

Recommendations:

4a. Place increased emphasis on the licensee's safety responsibility by requiring more safety research of the industrial community.

The electric utility industry now supports two common organizations, the Electric Power Research Institute and the Institute for Nuclear Power Operations, that perform research and assess and develop operational expertise for the industry as a whole. The utilities, in exercising their safety responsibilities, should be strongly encouraged to devote increasing resources to these efforts. As NRC gains confidence in these common industry organizations, its research budget should be gradually reduced and refocused on validating licensee research and verifying that reactor designs satisfy NRC's safety objectives.

5. *Finding:* Despite a strong recent trend toward increasing cooperation between the Office of Nuclear Regulatory Research and the industrial community, the current interface is not adequate for NRC researchers to incorporate maintenance and operations considerations into their safety research.

The witnesses and survey respondants were nearly unanimous in their judgment that the NRC relationship with industrial researchers has been improving significantly in recent years. They were also nearly unanimous in their view that substantial improvement in this relationship is still necessary and achievable. Dr. Zebroski, representing INPO, suggested in his testimony "that there could be better coupling [at NRC] with the lessons learned from INPO's review of operating experience and the findings and implications of the plant evaluation process."

NRC research has been attempting to account more realistically for the impact of operating and maintenance contraints on overall safety. Many of their programs explicitly model the effects of operator actions, the human-machine interface, and the contribution of maintenance deficiencies to plant safety. As evidenced at TMI, this trend is completely appropriate.

In his testimony before the Subcommittee, Chairman Palladino agreed that "Developing an understanding of the impact of the human element on safety requires input from organizations with actual operating experience." Nevertheless, the Subcommittee finds that the extent to which the current NRC research program relies on human performance data and understanding is not fully appreciated among industry research and operations groups. We also agree with Dr. Zebroski that industrial experience in this area is not used as heavily by NRC researchers as it should be.

Recommendations:

5a. Continue to increase substantive cooperative programs with EPRI and INPO involvement.

As mentioned in 4a above, the burden of safety research responsibility should gradually shift more and more heavily to industry. Participating in cooperative programs with EPRI and INPO is one way for NRC to encourage this shift while insuring that industry research is adequate both in quality and direction.

5b. Request EPRI or INPO review at the initiation or completion of any NRC research program involving operational procedures or reactions either as an input or as a deliverable product.

Given the complexity of plant operations impacts on overall safety, review of such programs by EPRI or INPO is a minimum requirement. Cooperative programs with EPRI or INPO are preferable to mere review.

5c. Formally invite EPRI comments on the NRC research budget and the Long Range Research Plan when these documents are reviewed by the Advisory Committee on Reactor Safeguards (ACRS).

Review of these documents by the ACRS has been extremely useful to the Commissioners, to the Office of Nuclear Regulatory Research, and to the Congress. Given that the ultimate impact of research on safety requires understanding and action by the electric utility industry, and that the quality of the research is often dependent on utility information and experience, a similar review from the utility perspective would be equally useful.

The Subcommittee does not feel that industry representatives should be party to internal NRC budget discussions. However, the availability of EPRI comments during Congressional review of NRC's budget would help the Congress to view the research program in a more complete context.

Mr. Minogue testified that EPRI already comments on the Long Range Research Plan. The Subcommittee feels that these comments should be formally requested each year and made public by the Commission.

6. *Finding:* The interface between the Office of Nuclear Regulatory Research and the Department of Energy is neither clearly defined nor well understood.

The views of the NRC, the DOE, and industry representatives on the appropriate interface between NRC and DOE research efforts vary widely. Responses to a question in the industry survey about appropriate research and development for DOE cited development of advanced reactors, conduct of comparative safety studies of alternative technologies for electric energy generation, and coordination of interactions between NRC and industry researchers. There was a general consensus that the interface between the two should be clarified.

Mr. Minogue in his testimony defined an appropriate role for the Department of Energy as conducting development to determine feasibility of concepts for improved safety or reliability identified by NRC.

The Nuclear Safety Research Development and Demonstration Act of 1980 (Public Law 96–567) tasked DOE with establishment of a comprehensive research, development, and demonstration program. Mr. Gordon Chipman, representing the Department of Energy, defined DOE's response to Public Law 96–567 as including four steps:

1. Identification of safety issues;
2. Review of work underway today to address the issues;
3. Definition of programs to resolve remaining issues; and
4. Development of a plan for prioritizing and implementing these programs.

This approach envisions DOE as the agent for defining and coordinating an overall program but not necessarily managing all components of the program.

In summary, the Subcommittee discovered considerable uncertainty among industry representatives and significant differences between DOE and NRC about the proper interface between the two agencies in regard to their research and development responsibilities.

Recommendations:

6a. Establish with DOE a cooperative review committee to coordinate research of mutual interest and to recommend regulatory changes to reflect research results.

This would help fulfill legislative mandates of both the Energy Reorganization Act of 1974 (Public Law 93–438) and the Nuclear Safety Research Development and Demonstration Act of 1980 (Public Law 96–567).

It is important to emphasize that this committee would serve in an advisory capacity only. It is not intended to undermine in any way the integrity of the NRC in exercising its regulatory responsibilities.

6b. Negotiate specific memoranda of understanding with the Department of Energy to cover LWR safety research, advanced reactor safety research and research on safe management of nuclear waste.

Despite a number of formal and informal agreements between the Commission and the Department of Energy to exchange information and work cooperatively, there are no existing memoranda of understanding between the two agencies which clearly delineate their respective research roles. The recommended memoranda need not be so detailed as to interfere with the execution of the duties of the NRC or DOE as they perceive them. Nevertheless, the agreements should at least define the roles of each organization, describe how they interrelate, and propose formal procedures for avoiding duplication of effort.

6c. Review all current research at NRC and DOE on advanced reactors and waste management. Coordinate the respective programs of the two organizations to eliminate any unnecessary duplication of effort.

All NRC research in these areas should be reviewed immediately, whether directed by the Office of Nuclear Regulatory Research or by user offices. The results of the review will aid in the definition of appropriate research roles for the two agencies as well as providing evidence of potential duplication of effort or neglect of important research needs.

6d. Continue cooperating with the Department of Energy as they define a comprehensive reactor safety research program pursuant to Public Law 96–567.

If existing NRC research covers components of this program once defined, the NRC should supply DOE with a description of deliverables, a schedule, and a responsible NRC project manager, so that DOE can monitor and coordinate the programs. The Subcommittee sees DOE as an appropriate coordinator of public and private sector programs to improve reactor safety.

7. *Finding:* Research activities at NRC not directed by the Office of Nuclear Regulatory Research are not adequately integrated with the overall research program.

The NSOC Reactor Safety Research Review Group stated in its report that:

> The NRC * * * also conducts many activities resembling research in its Technical Assistance Programs. These are not usually defined as research, even though some programs under the rubric of technical assistance have been long-term and have been exploratory in nature.

Under questioning by the Subcommittee, Chairman Palladino agreed that:

> * * * There would be benefit in looking at the whole picture [including technical assistance] when [NRC] look[s] at research.

He also expressed the opinion that:

> * * * There is a certain amount of importance in keeping the technical assistance in the hands of the office that has to have prompt answers.

Mr. Arsenault, testifying in support of the Commissioners concerning coordination on waste management between the Office of Nuclear Material Safety and Safeguards and the research office cited the organizational structure and the physical proximity of the offices as factors in their close relationship.

While the Subcommittee concurs in Chairman Palladino's judgment that technical assistance contracts should be primarily directed by the user offices requesting assistance, we are concerned with statements by NSOC and others that some of these programs require additional research. Without the research office involved, these programs could result in duplicative research or lead to conclusions not in full accord with the results of more comprehensive programs addressing the same issues. Our concern is heightened by the realization that comprehensive research results are often not reflected in the regulatory process whereas conclusions of technical assistance programs, however cursory, presumably fill immediate regulatory needs.

Recommendations:

7a. Coordinate all technical assistance programs through the Office of Nuclear Regulatory Research.

User offices should formally involve the research office in the initiation of technical assistance contracts. The research office should ensure that the work is coordinated with relevant research projects and that the conclusions are consistent with current research understanding. Technical assistance contracts which require extended programs should be integrated with the research program and funded under the same system of priorities. Current and projected technical assistance work should be related to associated research programs in the budget documentation provided to the Congress for each fiscal year. This will assist the Congress in conducting a meaningful review of all NRC research.

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APPENDIX A

List of Witnesses

May 18 1982:

Dr. Robert B. Minogue, Director, Office of Nuclear Regulatory Research, Nuclear Regulatory Commisson.

Dr. Chester P. Siess, Chairman, Nuclear Safety Research Program, Advisory Committee on Reactor Safeguards.

May 19, 1982:

Mr. Gordon Chipman, Deputy Assistant Secretary for Nuclear Reactor Programs, Office of Nuclear Energy, U.S. Department of Energy.

Mr. John Taylor, Director, Nuclear Power Division, Electric Power Research Institute.

Dr. Norman C. Rasmussen, Chairman, Reactor Safety Research Review Group, Nuclear Safety Oversight Committee.

Dr. Herbert J. C. Kouts, Vice Chairman, Reactor Safety Research Review Group, Nuclear Safety Oversight Committee.

Dr. Edwin Zebroski, Vice President, Engineering, Institute of Nuclear Power Operations.

Tuesday, June 15, 1982:

Hon. Nunzio J. Palladino, Jr., Chairman, U.S. Nuclear Regulatory Commission.

Hon. John F. Ahearne, Commissioner, U.S. Nuclear Regulatory Commission.

Hon. James K. Asselstine, Commissioner, U.S. Nuclear Regulatory Commission.

Hon. Victor Gilinsky, Commissioner, U.S. Nuclear Regulatory Commission.

Hon. Thomas M. Roberts, Commissioner, U.S. Nuclear Regulatory Commission.

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APPENDIX B

Industry Questionnaire on NRC Research Program

The staff of the Subcommittee on Energy Research and Production conducted a survey of nuclear industry representatives in conjunction with hearings May 18 and 19 and June 15 on the Nuclear Regulatory Commission research program.

The respondants generally felt that the NRC research program has become more meaningful in the last few years. Nevertheless, the survey responses indicated general consensus on the following points:

—NRC has mandated a number of "safety fixes" without proper assessment of their impact on overall plant safety;

—Although the NRC program now covers the most important areas of safety research, it still lacks sufficient focus on key issues and often pursues research beyond the point of maximum benefit;

—Cooperative research programs between NRC and industry produce results more efficiently and effectively than separate programs;

—Industry should be encouraged to review NRC programs, especially during formative stages of new projects;

—NRC research results which would reduce unnecessary conservatism are not adequately reflected in NRC regulations whereas findings which would increase conservatism are immediately applied, often on the basis of limited and inconclusive tests;

—NRC needs a more systematic approach to establish research priorities;

—Improved communication is still required between the research and licensing offices of the NRC.

Individual answers to the survey questions will not be published because respondants were promised anonymity. However, the attached material summarizes responses to each of the questions asked.

NRC Research

Summary of industry questionnaire responses

Question 1. Many people have criticized the NRC in that too many ad hoc "safety fixes" have been mandated without a proper assessment of their impact on the overall safety of powerplants. Do you agree with this criticism? If yes, please provide any examples of safety fixes that may compromise safety and explain what the NRC should do in its research effort to help rectify their current approach.

Summary of responses.—Nearly all respondants agreed with this criticism and numerous examples were cited. The responses, however,

were primarily aimed not at innaccurate or misleading research results, but at lack of communication between the regulatory and research offices of the NRC. A number of the respondants were aware that the problem is recognized within the NRC; two quoted the NRC survey of utility management (SECY–81–437, July 22, 1981) which found that "the pace and nature of regulatory actions have created a potential safety problem of unknown dimensions." The creation of a Deputy Executive Director for Regional Operations and Generic Requirements was lauded by a number of respondants as a step in the right direction.

Among those "safety fixes" which respondants cited as not sufficiently researched for their overall impact on the public health and safety were reactor vessel head vents, water level indicators, some emergency procedures, initial primary coolant pump shutdown recommendations after TMI, seismic design for piping, and automatically closing fire dampers in ventilation systems.

Many respondants discussed general factors which they felt should be taken into account in future regulatory "safety fixes." Among these were the impact of design changes on plant complexity, judicious timing of requirements to minimize operator training deficiencies, and the uncertainty engendered by requiring state-of-the-art technology without sufficient testing.

Additional steps which respondents felt could improve NRC performance in the future are increased use of probabilistic risk assessment techniques to investigiate competing risks, development of improved plant system analysis tools, increased communication between the regulatory offices and safety researchers both at NRC and in industry, and industry input and peer review during the scoping and justification of research programs as well as at the completion.

Question 2. In your estimation, does the NRC research program properly focus its efforts on the most important issues for overall safety? If not, please explain. Do you feel that the NRC research program is responsive to the NRC mission to protect the public health and safety and the common defense and security in the civilian uses of nuclear energy?

Summary of responses.—This question evoked a less uniform response than Question 1. However, a number of predominant themes were expressed.

Many of the respondents noted that although the NRC in the past had neglected some important safety issues. they have recently been moving to rectify this situation. In general, the respondants indicated that NRC currently covers the most important areas for safety research. Considerable concern was expressed, however, about the focus of NRC research programs and their relationship to key safety issues. Respondants stated that NRC often pursues its research programs beyond the point of maximum benefit, consuming resources that could be more productively applied to other issues. Inadequate communication between regulatory and research offices, and undue emphasis on extremely unlikely accident scenarios were other concerns noted. Nearly every response that mentioned specific issues focused on the need for definitive information about the release and transport of fission products during severe accidents.

Question 3. Do you feel that there is sufficient interaction between the NRC research staff and industry to allow the staff to make informed trade-offs between design and operating constraints? If not, how could this interface be improved?

Summary of responses.—Respondants generally indicated that current interactions between NRC and industry are inadequate, but that the situation has improved markedly in recent years. A number pointed to the industry IDCOR program as an outstanding example. The adversarial relationship which had existed in the past was criticized as counterproductive and inefficient. Increased cooperation with industry was seen as one way to conserve resources by reducing duplicative research and sharpening the focus of NRC research.

Many of the respondents recommended more widespread use of advisory groups, particularly in early phases of new projects. It was suggested that industry could assist the NRC in designing programs to yield results that are more directly applicable. It was also suggested that NRC seek industry recommendations on the scope of current and planned R&D programs. These steps were seen as ways to increase the incentive for NRC to resolve safety issues as quickly as possible and to terminate associated research programs in a more timely manner. One respondent remarked that high-level agreements between NRC and industry groups such as EPRI and INPO don't seem to filter down to the staff level.

Question 4. Do you feel that NRC research results are adequately reflected in the licensing activities of the NRC? If not, please cite counter examples.

Summary of responses.—This question evoked unanimous and emphatic responses to the effect that research results are inadequately reflected in NRC regulations, particularly when they would result in relaxed requirements. Many respondents noted a marked contrast between findings implying a need for increased regulatory conservatism which are immediately acted upon even on the basis of limited and inconclusive results, and findings demonstrating unnecessary conservatism which are subjected to exhaustive and interminable research programs before having any impact. An example offered of the former were post-TMI requirements which were mandated prior to research. In some cases subsequent research has shown them to be ineffective or counter to overall safety. The two most heavily used examples of accepted results not reflected in the regulatory process were the LOFT tests on Emergency Core Cooling Systems, which have not been reflected in 10 CFR 50, Appendix K, and the indications on iodine release and transport at TMI. Many respondents favored an acceleration of current research on fission product release and transport, and possibly a conservative but more realistic interim set of assumptions. Some responses implied that research results are only used when they support models already accepted by the regulatory offices.

One respondent provided an interesting and thoughtful response which noted a fundamental incompatibility of format between current regulatory practice and research results. He described the regulations as formalistic requirements which by their very nature fragment the plant into subsystems, whereas many research programs deal by necessity with complex interactions among subsystems having an integrated effect on the overall plant. This respondent was concerned with the

loss of valuable information when research results are cast in the current regulatory formats.

Question 5. Are NRC research results useful to industry in designing and operating reactors? Are the results readily available to industry in usable form?

Summary of responses.—The consensus among respondents is that research results are generally available to industry but only marginally useful. Computer codes were cited as benchmarks for industry codes but not replacements. A few respondents noted a fundamental difference in perspective, with NRC concentrating on worst-case accidents and industry emphasizing day-to-day operations and more probable accident sequences. Some of those who responded with examples of research useful to industry recommended more emphasis on proper documentation and quantitative analysis.

Question 6. What should be the priorities of the DOE safety research program? What can be done to improve the interface between NRC and DOE?

Summary of responses.—Responses demonstrated more differences among respondents than answers to any other question. Among those roles envisioned for DOE, the most prevalent were development of advanced reactors, conduct of comparative safety studies of alternative technologies for electric energy generations, and coordination of interactions between NRC and industry researchers. With the execption of one respondent who felt that interaction between NRC and DOE is immaterial given their respective budgets, there was a general consensus that the interface between the two should be clarified. However, various suggestions included a definitive line drawn between the two agencies, a major focus for each with overlapping responsibilties, or a single agency (most logically NRC) in charge of safety research with the other (DOE) exercising oversight and review.

Some respondents felt that DOE could develop a better focus on overall safety because it is unimpeded by the specific regulatory structure of the NRC. DOE was complimented on the formation of working groups pursuant to Public Law 96–567 as a potentially effective method of establishing safety priorities, but some respondents called for stronger management of the program. The recommendation most common to all responses was the establishment of a systematic approach to setting priorities for a national reactor safety program including all safety research participants.

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